New research finds ocean warming forces reefs into cool-water refuges

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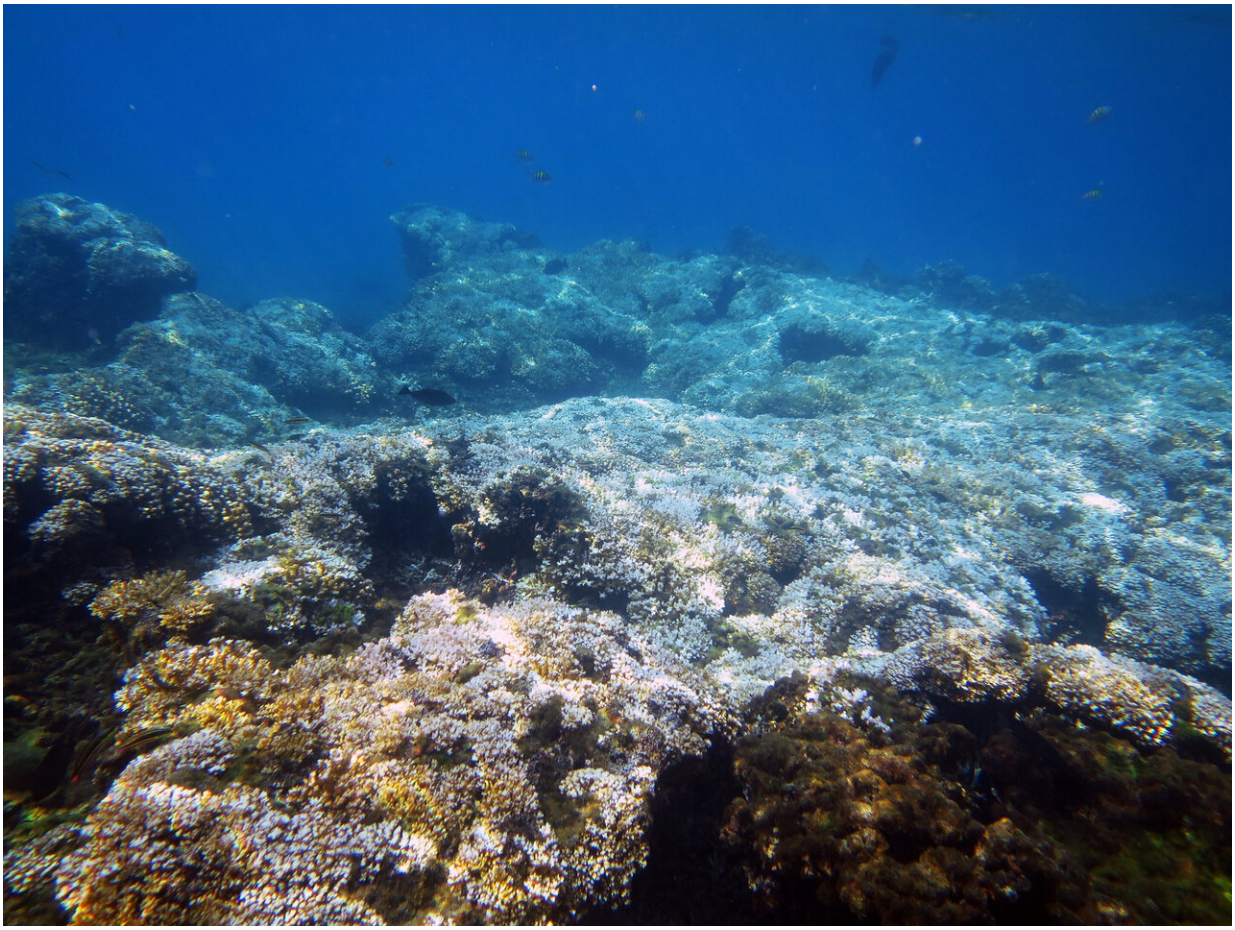

This coral has bleached at high ocean temperatures in the non-upwelling zone off Pacific Panama. New research finds that habitats once too cold for coral may provide refuge as ocean temperatures rise. Credit: Lauren Toth

New research from Florida Tech finds that global warming is shifting which environments off the Pacific coast of Panama will support coral reefs. Historically warmer areas that promoted fast coral growth are now becoming intolerably hot, and habitats that for thousands of years were too cold will offer some protection from the heat and temporarily promote thriving coral populations.

The study, "Upwelling buffers climate change impacts on coral reefs of the eastern tropical Pacific," published online this week in *Ecology*, is a collaborative effort among ocean scientist Rich Aronson from Florida Tech and colleagues at the Australian Institute of Marine Science (AIMS), the United States Geological Survey (USGS) in St. Petersburg, Florida, and other institutions. It shows that upwelling zones, which are areas where cold, deep water comes up to the surface, can counteract the effects of a rapidly warming ocean. Reef surveys and field experiments showed that the corals grew better on reefs with strong upwelling.

"High temperatures disrupt the delicate balance between corals and the single-celled algae that live inside them and provide them with food," said lead author Carly Randall, a postdoctoral scholar at Florida Tech who is now at AIMS. "Cooling from upwelling, especially during super-hot El Niño events like the one in 2015–2016, provides some relief."

Lauren Toth of the USGS said that some portions of the Panamanian coastline feature strong upwelling in the winter months, but along other stretches of the coast upwelling doesn't happen.

"It's pretty intuitive," said Toth, who like Randall received her Ph.D. from Florida Tech. "The trade winds blow across the Isthmus of Panama from the Caribbean. Where there are no mountains to block the trades, shallow water gets pushed away from the coast and out into the Pacific, and cold, deep water flows in to replace it. In other areas, mountains block the winds and suppress upwelling."

"There are upwelling zones scattered all over the world, and we will see shifts in where coral reefs grow best," Florida Tech's Aronson said. "But because global temperatures are going up so fast, upwelling will be no more than a temporary refuge for corals."

He concluded, "This is another sign that we're running out of time. We know that the main cause of climate change is our emissions of greenhouse gases. We need to control those greenhouse-gas emissions, and we need to do it now."

More information: Carly J. Randall et al. Upwelling buffers climate change impacts on coral reefs of the eastern tropical Pacific, *Ecology* (2019). DOI: 10.1002/ecy.2918

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